Power:

$$P = \frac{W}{t}$$

W → work

t → time

P → Power

Units: Watt (W) = $\frac{\text{Joule (J)}}{\text{second (s)}}$

$$P = \frac{Fd}{t}$$

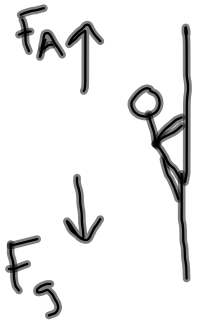
$$= F v$$

- We have to be careful with the force that is used.

- Force used to calculate is the force that is causing the object to move. If there are more forces or acceleration, we must use Newton's 2nd law to calculate applied force.

Power Notes and Practice Problems 4.16.12 Honors Physics

A 50 kg student climbs 5 m up a rope at a constant speed. If the student's power output is 200 W, how long does it take the student to climb the rope?



because constant velocity,

$$F_A = F_g$$

$$P = \frac{W}{t}$$

$$= \frac{F_A d}{t}$$

$$F_A = F_g = ma_g = 490 N$$

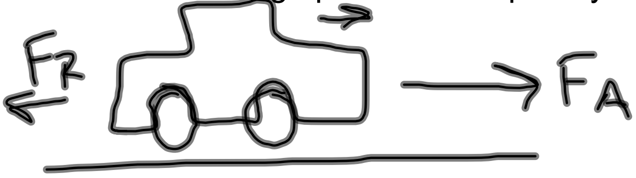
$$t = \frac{F_A d}{P}$$

$$= \frac{(490 N)(5 m)}{200 W}$$

$$= 12.25 s$$

Power Notes and Practice Problems 4.16.12 Honors Physics

A car with a mass of 1500 kg starts from rest and accelerates to a speed of 18 m/s in 12 s. Assume that the force of resistance remains constant at 400 N during this time. What is the average power developed by the car's engine?



$\rightarrow +$

$P = F_{net} V_{avg.}$

$= (2650\ N)(9\ m/s)$

$= 23850\ W$

$V_{avg} = \frac{V_f - V_i}{2}$

$= \frac{18\ m/s - 0\ m/s}{2}$

$= 9\ m/s$

$\Sigma F = ma$

$F_A - F_R = ma$

$F_A = F_R + ma$

$= 400\ N + (1500\ kg)(1.5\ m/s^2)$

$= 2650\ N$

$a = \frac{V_f - V_i}{t}$

$= \frac{18\ m/s - 0\ m/s}{12\ s}$

$= 1.5\ m/s^2$

An average force of 587.5 N is exerted as the Coyote stretches the string back on a giant bow. The string is moved back a distance of 0.744 m as he inserts his body in the bow. His mass is 14.57 kg, and it takes him 3.0 s to do this task. He points himself in a horizontal direction, and when the Road Runner passes he takes off from the bow. How fast is he going at his maximum horizontal velocity?

$$K = \frac{1}{2}mv^2$$

$$U_g = mgh$$

$$W = \Delta E$$

$$Fd = (K_f - K_i^{\,0}) + (U_{gf}^{\,0} - U_{gi}^{\,0})$$

$$Fd = \frac{1}{2}mv_f^2$$

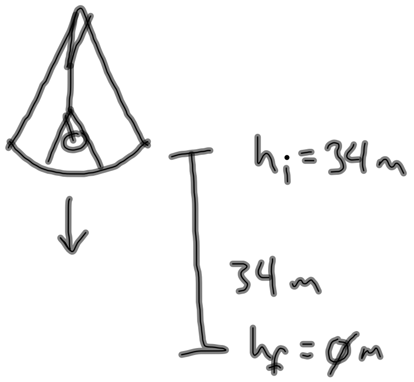
$$v_f = \sqrt{\frac{2Fd}{m}}$$

$$= \sqrt{\frac{2(587.5\text{ N})(.744\text{ m})}{14.57\text{ kg}}}$$

$$= 7.75\text{ m/s}$$

Power Notes and Practice Problems 4.16.12 Honors Physics

Failing to capture the Road Runner on his last attempt, the Coyote uses the same bow again. The only difference this time is that he starts from a cliff 34.0 m high and points the bow/himself straight down. All other data is exactly the same. In this situation, how fast will he be moving as he hits the ground?



$$W = \Delta E$$

$$Fd = (K_f - \cancel{K_i}^{\,0}) + (\cancel{U_{gf}}^{\,0} - U_{gi})$$

$$Fd = \frac{1}{2} m v_f^2 - m a_g h_i$$

$$\frac{1}{2} m v_f^2 = Fd + m a_g h_i$$

$$v_f = \sqrt{\frac{2}{m}\left(Fd + m a_g h_i\right)}$$

$$= \sqrt{\frac{2}{14.57\,kg}\left[(587.5\,N)(.744\,m) + (14.57\,kg)(9.8\,m/s^2)(34\,m)\right]}$$

$$= 26.9\ m/s$$